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MANGOLD WURZELS AND SUGAR BEETS

1 COMPARISON OF VARIETIES
2 TRANSPLANTING
3 CONTINUOUS CROPPING, WITH AND WITHOUT MANURE
4 DISPOSAL OF LEAVES
5 SUGGESTIONS FOR BEGINNERS IN BEET CULTURE

Offices and Experiment Grounds on the Farm of the Ohio State University

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MANGOLD WURZELS AND SUGAR BEETS.

BY J. FREMONT HICKMAN.

INTRODUCTION.

For a series of years this Station has been cultivating mangold wurzels, primarily for the purpose of furnishing food for the dairy cows kept on the farm. During the last four years considerable attention has been given to the testing of the comparative productiveness of the many so-called varieties, and during the last three years some investigation has been made upon the methods of manuring land for beets, and as to advantages or disadvantages of transplanting mangold wurzels. In connection with the above some practical points have been gathered which will be treated of under a separate division.

The subject under consideration will therefore be treated under the following general headings:

1. Comparison and classification of varieties.
2. Transplanting.
3. Continuous cropping, with and without manure.
4. Disposal of leaves.
5. Suggestions for beginners in beet culture.

1. COMPARISON AND CLASSIFICATION OF VARIETIES.

In conducting a comparative test of varieties of mangold wurzels I have found it almost impossible to secure any thing like a complete test, because it is so difficult to get seed of uniform vitality. I deem it necessary to test the vitality of each lot of seed, then plant accordingly; even

with this precaution it is next to impossible to secure a perfectly uniform stand of mangolds. The work of the first, second and third seasons in variety testing was not entirely satisfactory, but that of the fourth year was more nearly so. The major portion of the matter in this bulletin is therefore made up from the last season's work, though some of the data of the earlier years is incorporated. From the experiments of the four years I am enabled to draw some conclusions that would have been impossible to draw from the work of one or even two seasons.

TABLE I.—MANGOLD WURZELS AND SUGAR BEETS.—COMPARISON OF VARIETIES

Plot No	Name of variety.		Yield per acre.	
			Actual.	Corrected.
			Tons.	*Tons*
1	Giant Long Red	Livingston's Sons	16.15	16.15
2	Jumbo	Maule	16 35	16 35
3	Giant Yellow Intermediate	"	19.81	21.91
4	Gate Post	"	12.80	16.54
5	Giant Long Red	Livingston's Sons	16.80	16.80
6	Red Globe	D. M. Ferry	14 60	17.27
7	Yellow Ovoid	"	15.15	18.01
8	Yellow Globe	"	14.05	14.05
9	Giant Long Red	Livingston's Sons	15.90	15.90
10	Carter's Warden Prize Yellow	D. M. Ferry	11 30	14 28
11	Yellow Leviathan	"	16 75	22.44
12	Beehive Yellow	Vaughan	10.90	17 44
13	Giant Long Red	Livingston's Sons	13 50	16 20
14	Eschendorf Yellow	Vaughan	13 00	18.70
15	Eiffel Tower	J A. Salzer	16.58	16 58
16	Giant Holstein	"	17.09	17.09
17	Giant Long Red	Livingston's Sons	16.10	16.10
18	Digoity	N. B & G Co	13 27	14.68
19	Mammoth Golden Giant	"	7.45	14 52
20	White French Sugar	V. H Hallock	7 70	7 70
21	Giant Long Red	Livingston's Sons	14.30	14 30
22	Carter's Sugar Cane	Dreer	10.37	10 37
23	Simond Le Grande	Imported seed	6 90	.....
24	Bulteau Desprez Richest	"	8 30	.....
25	Dippe's Vilmorin	"	7 45	.....
26	Florimond Desprez Richest	"	8.70	.....
27	Dippe's Klein-Wanzleben	"	7 60	.....
28	Clark Castle	Seed of 1890	9 56	.....
29	Eiffel Tower	"	9 10	.....
30	Jersey Queen	"	8.12	.....
31	Golden Tankard	Jerrard	7 60	.....
32	Colossal Long Red	"	7.41	.....

The land used for the variety tests of 1891 was a timothy sod of four years' standing. It was plowed on April 13th and 14th, then rolled and harrowed until it was in perfect tilth, and marked in rows thirty-three inches apart. The seed was drilled in May 5th, with an Iron King seed drill, which covered it about one inch deep. Nineteen differently named

sorts of mangolds and seven so-called varieties of sugar beets were planted, allotting to each one-tenth acre. They were planted in the order given in Table I; duplicates of the Long Red were put in to serve as guides in making comparison of yields. Table I gives actual and corrected yields of the several sorts of mangold wurzels and sugar beets, the corrected yields being the estimated product if the ground had been fully occupied. It must be conceded that the corrected yields do not furnish absolute, but simply possible results; they are given only as approximate figures to guide in making comparisons. To illustrate: We may take plots 1 and 12, if actual yields only were given the reader must infer that the difference between 16.15 tons and 13 50 tons to the acre is due to variation in soil, or possibly in cultivation; but when he has the figures of possible yield in each case he sees at a glance that the variation is caused by an imperfect stand. Where the actual and corrected yield are the same the plots have been considered as having a perfect stand.

Plots 27, 28 and 29 were planted with seed kept over one year; the distribution of plants on these plots and upon Nos. 30 and 31 was fairly uniform, but the seed lacked vitality and the plant did not make a vigorous growth. Plot 14 was a duplicate of 28, but was planted with new seed; the yields indicate a very wide difference in productiveness between old and new seed. From the same purchase of seed from which these three plots were planted, these same varieties were planted in 1890, and gave as high an average yield as the other varieties of their class, as classified in Table II, giving a specific indication that the falling off in yield was due to old seed. The names in the second column in Table I indicate the firms from which the seed was purchased.

The sugar beet seed was imported by the Department of Agriculture and by that Department distributed. The seed planted in 1891 was from the same importation as the seed that was used in 1890, but the yield from the several varieties was, all things considered, equally as high in 1891 as in 1890; this would seem to show a direct contradiction to the experiment with the old seed of the mangold wurzels, were we sure that the Department seed was fresh when distributed.

We are not able to discover any cause for the low yields of plots 22 to 31 inclusive, except differences in variety or in quality of seed. The land is apparently uniform and the treatment was uniform.

The classification in table II is an arbitrary one and is based upon the form of the mangold wurzel, as indicated by the name given each class. Further characteristics are found peculiar to each class, namely: The Long Red, aside from the form of the root, has red stems and red veins in the leaf; the Ovoid leaf stems and veins are yellow or white, and the surface

of the mangold partakes of the same color; the Globe class in this classification takes its name wholly from its form, the stems and leaves having the characteristics of both the foregoing classes; the Sugar Beet class is a distinct one; the shape in general is that of an inverted cone, flesh white, leaf stems and veins white or yellow tinged.

TABLE II.—MANGOLD WURZELS AND SUGAR BEETS—CLASSIFICATION AND COMPARISON OF DIMENSIONS.

Class and Variety.	Dimensions.		Average weight.
	Average length	Average diameter	
	Inches	*Inches*	*Pounds*
Long Red—			
Giant Long Red	16 80	3 25	1 25
Jumbo	16 70	3 45	1 25
Eiffel Tower	15 15	3.25	1 40
Giant Holstein	14 25	3 25	1 45
Dignity	17 25	4 00	1 35
*Chirk Castle	13 45	2 80	0 80
*Jersey Queen	13 95	2 00	0 85
Collossal Long Red	13 25	2 20	0 55
†*Average of class*	16 03	3 44	1 34
Ovoid—			
Mammoth Golden Giant	14 15	5 00	1.25
Golden Tankard	10.30	2 35	0 50
Giant Yellow Intermediate	15 00	3.70	1.55
Gate Post	15 00	3 75	1.25
Yellow Ovoid	13 80	3 65	1 25
Carter's Warden Prize Yellow	10 20	4 00	1.05
Yellow Leviathan	14 40	3 80	1 35
Eschendorf Yellow	12 30	4 20	1 35
Average of class	13.14	3 80	1.19
Globe—			
Red Globe	11.05	4 55	1 25
Yellow Globe	10 80	4 40	1 00
Beehive Yellow	9 85	4 25	1.20
Average of class	10 56	4 40	1.15
Sugar Beets—			
Carter's Sugar Cane	12 50	3.30	0.75
White French Sugar	13 00	2 90	0 80
Bulteau Desprez Richest	11.85	2.50	1.00
Dippe's Vilmorin	11 70	3.05	0.70
Florimond Desprez Richest	12 25	3.45	0.95
Dippe's Klein Wanzleben	11 00	2 80	0.75
Simond Le Grande	10 00	2.80	0.95
Average of class	11 75	2.97	0.84

*Old Seed.

†This average omits the varieties grown from old seed

Botanists consider the mangold and sugar beet as simply varieties of the common garden beet, *Beta vulgaris*; the differences in varieties having resulted from special selection and culture directed to the fixing of certain accidental valuable qualities. Thus the main feature sought in the development of the mangold wurzel has been large size, while in the sugar beet a large percentage of sugar has been the object. I am of the opinion that the entire list of names given in the Long Red class in Table II are but strains of one variety, and that the varying yields are simply results of breeding, or of the degree of care taken in the selection of seed. The Ovoid class is of a less decided type, and may be made up of two or possibly three well defined strains. In the Globe class, as in the Ovoid, we have about the same variations in color and some marked variations in shape.

The dimensions given in Table II were found by carefully measuring and weighing twenty specimens, just as they grew in the row, and taking the average. The above figures give a fair idea of the normal size of mangold wurzels and sugar beets, but it may be well to add that they do not give a clear conception of the possible size and yield. We have grown mangolds without extra care weighing fourteen pounds, and in one instance produced at the rate of more than fifty-four tons per acre, but such yields are rare.

As planted in this experiment, a perfect stand would have given 27,210 beets to the acre. At the average weight of the different classes this would have given eighteen tons per acre for the Long Red class, seventeen and one-half tons for the Ovoid class, fifteen tons for the Globe class and eleven and one-half tons for the sugar beets. Our "corrected yields" give an average of sixteen tons for the Long Reds, (omitting plots 27, 28, 29 and 31), eighteen tons for the Ovoids (omitting plot 30), sixteen tons for the Globes, and an actual yield of eight tons for the sugar beets, the stand on these plots being so irregular that no attempt was made to correct the yield to full stand. Judging from the weight of beets, an estimate of eleven tons per acre as the yield from good seed would not be far out of the way.

Table III shows the yield of each sort in tons per acre, the per cent. of dry matter, the total dry matter produced on an acre, and the averages of the same by classes. The average actual yields of the first three classes are practically the same. The per cent. of dry matter averages higher in the Long Red class than in the Ovoid, and higher in the Ovoid than in the Globe, but these variations are not nearly so great between classes as they are between individual sorts in those classes. In the Long Red class we have a variation of three per cent. which is the equivalent of nearly

one third greater yield of dry matter from an equal number of tons in the one sort more than in the other.

TABLE III.—Relative Production of Dry Matter in Mangolds and Sugar Beets.

Class and Variety.	Yield per acre.	Per cent. of dry matter	Dry matter per acre.
	Tons	*Per cent.*	*Pounds.*
Long Red—			
Giant Long Red	15.45	9.34	28.80
Jumbo	16.35	10.00	32.60
Eiffel Tower	16.58	11.34	37.60
Giant Holstein	17.09	11.34	38.60
Dignity	13.27	12.34	32.60
*Chirk Castle	9 56	11.00	21.00
*Jersey Queen	8.12	9 34	15.00
Collossal Long Red	7.41	9.67	14.40
Average of class	12.98	10.54	27.58
Ovoid—			
Mammoth Golden Giant	7.45	12.80	19.00
Golden Tankard	7.60	9.20	13 80
Giant Yellow Intermediate	19 81	9.67	38.20
Gate Post	12.80	9.34	23.90
Yellow Ovoid	15.15	10.34	31.12
Carter's Warden Prize Yellow	11.30	11.60	26.20
Yellow Leviathan	16 75	10.00	33.70
Eschendorf Yellow	13 00	9 20	23 90
Average of class	12 98	10.27	26.23
Globe—			
Red Globe	14.60	10 00	29.20
Yellow Globe	14.05	8 80	24.60
Beehive Yellow	10.90	8.00	17.44
Average of class	13 18	8.93	23.74
Sugar Beet—			
Carter's Sugar Cane	10.37	12 04	24.80
White French Sugar	7.70	18.80	28 85
Bulteau Desprez Richest	8.30	15.60	25 80
Dippe's Vilmorin	7 45	17.20	25 60
Florimond Desprez Richest	8.70	14.00	24.20
Dippe's Klein Wanzleben	7.60	16.40	24 80
Simond Le Grande	6 90	14.40	19.80
Average of class	8 14	15.49	24 83

*Old Seed.

From this table it is found that the average mangold wurzel contains 90 per cent. of water; in the list given the highest percentage is 92 and the lowest 87.20. Since the value of any feeding stuff is determined by the quantity and quality of the dry matter it contains, in selecting a strain

of mangolds to grow for the production of food that strain should be chosen that will give the highest yield in pounds of dry matter per acre.

The lowest percentage of dry matter in the sugar beet class of this same table is almost as high as the highest in any of the mangold wurzel classes, and the average per cent. of dry matter is more than 50 per cent. greater; thus it is possible to handle one-third less tons and yet have the same amount of feed in a more concentrated form than if it were handled in the greater number of tons.

Attention is here called to the fact that it is possible to grow one-half more sugar beets per acre than is indicated by the table given. In growing this class for sugar they are usually planted in rows from eighteen to twenty inches apart, while the tonnage here given was produced by growing them in rows thirty-three inches apart. It is quite within bounds to say that in growing roots for feed it is possible to produce more food from an acre of sugar beets than of mangold wurzels, and indeed, in this experiment, if we were to take the theoretical yields obtained by weighing average specimens of beets, we would have a yield of 3,560 pounds of dry matter from the sugar beets, against 3,690 pounds for the Ovoids and 3,360 pounds for the Long Reds.

TABLE IV.—DRY MATTER AND SUGAR IN VARIETIES OF SUGAR BEETS GROWN UNDER DIFFERENT CONDITIONS.

Variety.	Grown isolated.		Grown densely.	
	Dry matter.	Sugar.	Dry matter.	Sugar.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Dippe's Klein Wanzleben	16.40	7.51	20 00	8.02
Dippe's Vilmorin	17.20	6 32	20.50	6 43
Simond Le Grande	14 40	5.73	18.60	4.27
Florimond Desprez Richest	14.00	5.79	19.00	6 85
Bulteau Desprez R chest	15 60	6.83	12 18	5.75
White French Sugar	18.80	6.30	.....	.....
Carter's Sugar Cane	12 04	5.02	.....	....
Mangold Wurzels—				
Golden Tankard	9.20	3.21	.....	....
Yellow Globe	8.80	3.45	.....	....
Beehive Yellow	8.00	2 01	.....	.....
Eschendorf Yellow	9.20	3 25	....	.....

Table IV shows the results of an experiment suggested by the assertion that sugar beets grown close together will yield a higher per cent. of sugar than if grown at greater distance. Satisfactory samples of the last two of the seven sugar beets were not obtained, but four out of the five samples taken show a much higher per cent. of dry matter, and three of

the five give higher percentages of sugar where they were grown densely. It is found that the percentage of dry matter in this class varies as much as in any of the preceding classes, indicating that selection of variety may have much to do with final results.

If the assumption is correct that the yield of sugar beets can be increased one-half, then, according to the foregoing tables, it is possible to produce on an average as many pounds of sugar beets per acre as of mangolds, and since the average analysis shows fifty per cent. more dry matter, the conclusion reached is that one ton of average sugar beets is worth as much for feeding purposes as one and one-half tons of average mangold wurzels, and that an acre of sugar beets is worth more than an acre of mangold wurzels.

COST OF PRODUCTION.

For the last two seasons a careful record has been kept of the cost of producing an acre of beets. In 1890 the account stood as follows:

Preparation of land	$4 00	
Seed	1 20	
Cultivation	15 40	
Harvesting and storing	10 76	
Rent of land	6 00	
		$37 36

The preparation of the seed bed in 1891 required more work, the plants required more cultivation, and instead of putting the beets in the cellar as in 1890 they were put into pits, so that there was also an additional cost in harvesting. The account for 1891 stands as follows.

Preparation of land	$7 44	
Seed	1 20	
Cultivation	17 88	
Harvesting and storing	12 32	
Rent of land	6 00	
		$44 84

I find these figures do not vary materially from those given for cost of producing an acre of sugar beets in California, where they are grown for sugar-making purposes. From a recent bulletin issued from the Experiment Station of Nebraska* I find the average cost of production as given by seven growers in California to be $44 85 per acre. In the same report (page 41) Table XIV indicates an average yield for that section (Watsonville, California) of 13.5 tons per acre. For these the "Western Beet Sugar Company" have paid $5.00 per ton, or an average of $67 50 per acre, show-

*Vol. V, No 21, page 59.

ing a profit of $22 65 per acre. Page 32 of the same bulletin gives the average yields of thirty-three growers near Grand Island, Nebraska; the figures are as follows: Yield, 13.6 tons per acre, containing 13.5 per cent. of sugar, and the average returns per acre $44 15.

Considering the low percentage of sugar found in the beets grown at this Station the outlook is certainly quite unfavorable for growing beets in this State at a profit. Unless the sugar content can be more than doubled, the growing of beets for profit must depend, not so much upon what the sugar in the beets is worth as upon what we can get per ton for them delivered at the factory. The evidence given here is not sufficient proof that sugar beets can not be grown at a profit in Ohio, but it does point out some facts which are worth considering before going into the business. Granting that we can grow thirteen tons to the acre (which is entirely possible), if our percentage of sugar should not average above 6 5 then our beet crop, according to prices previously given, would not bring to exceed $2.50 per ton, or about $32 00 per acre, and this falls below the cost of production.

Returning to Table IV the reader will find a partial analysis of four samples of mangold wurzels. They are placed in that Table simply to show the difference between mangold wurzels and sugar beets.

For all the analysis given in the foregoing tables credit is due to Mr. F. J. Falkenbach, acting chemist of this Station, who has done all of that work.

2. TRANSPLANTING.

Both in 1890 and in 1891 an experiment was made in the transplanting of mangolds. At the time when the main crop was thinned the best of those pulled out were selected and transplanted into rows which had been left for that purpose, so that the transplanted ones were grown on soil equally as good as that in which the others, not transplanted, were grown. A part of those so transplanted were left with the leaves undisturbed, while others, planted in separate rows, had the leaves pinched off at the base, leaving the stem entire. Table V gives the several dates on which these transplantings were made, also the conditions under which they were made, and the estimated yield per acre. These plantings were made among those grown in the experiment in continuous culture, and the yields should be compared with the average results there given The figures given in Table V indicate that, in general, transplanting mangold wurzels is not advisable, but that it may be done to fill up vacancies in rows to make a perfect stand. Fig. 1 is a reproduction from photographs of the mangolds grown in two ways; the lot on the left were transplanted

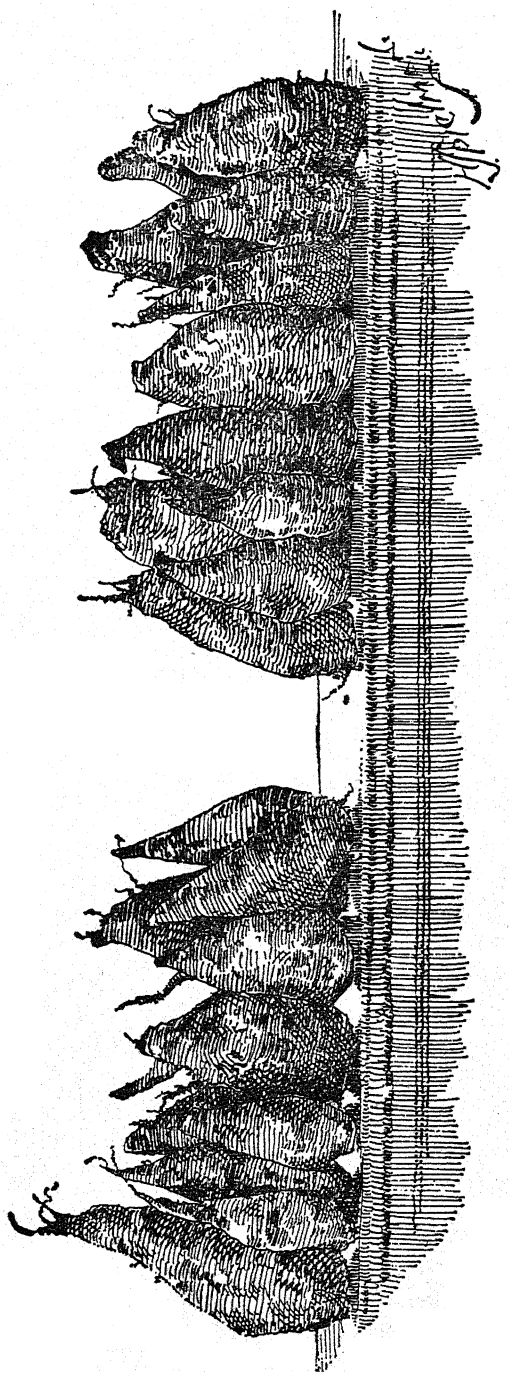


FIG. 1.

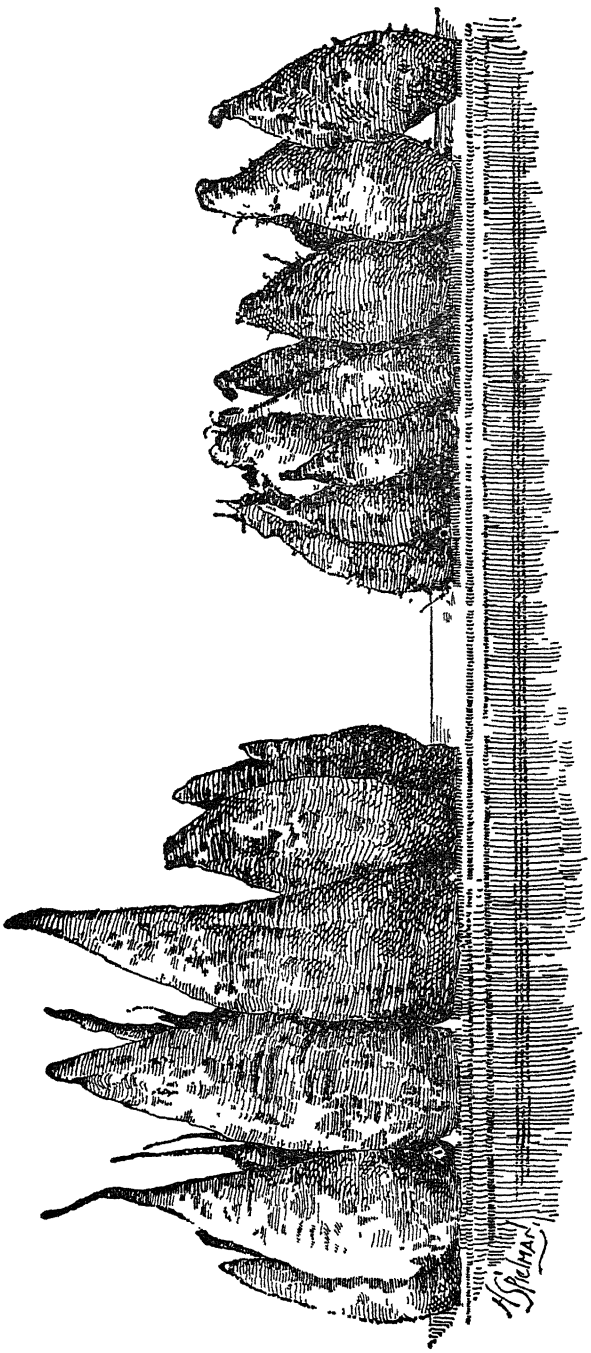


FIG. 2.

with top left on and those on the right with top pinched off Neither the figure nor table shows any decided variations between those having leaves pinched and those having leaves undisturbed when transplanted. Fig. 2 shows the difference between transplanted beets and those grown without transplanting.

TABLE V.—YIELDS FROM TRANSPLANTED MANGOLD WURZELS

Plot No		Tons per acre
		1890.
1	Transplanted June 11, leaves left on	6 00
2	Transplanted June 18, leaves pinched off	5 00
3	Transplanted June 25, leaves left on	4 75
4	Transplanted June 25, leaves pinched off	5 00
5	Transplanted July 1, leaves left on	3 00
		1891
2	Transplanted June 15, leaves pinched off	5 18
3	Transplanted June 15, leaves left on	6 06

3 CONTINUOUS CULTURE OF MANGOLDS ON THE SAME LAND, WITH AND WITHOUT MANURE

In 1889 an experiment was begun for the purpose of determining the effect of manuring ground for mangolds. To this end, three duplicate plots were set apart to be planted year after year without the use of fertilizers of any kind, while three others were to have manure applied to them at the rate of sixteen tons to the acre each year, just before plowing the land. With this exception the six plots were treated exactly alike; the plowing, harrowing, seeding, cultivating, harvesting, etc., were done upon the same dates, giving each a like chance with the others.

Diagram I represents the average actual yield of each plot for the three years, indicated by the solid lines The possible yields are represented by the extensions of the solid lines. In 1891 a seventh plot was added, upon which a rotation had been followed without manuring, and with similar treatment to the others. This plot had grown millet in 1889 and oats in 1890, and was seeded to mangold wurzels in 1891 for the purpose of indciating how much the continuous cropping with roots had deteriorated the land. The results are shown in Diagram II, and indicate that the growing of mangolds upon the same land continuously for three years has decreased its ability to produce that crop at least 30 per cent.

DIAGRAM I.—AVERAGE YIELD OF MANGOLDS FOR THREE YEARS UNDER CONTINUOUS CROPPING, WITH AND WITHOUT MANURE

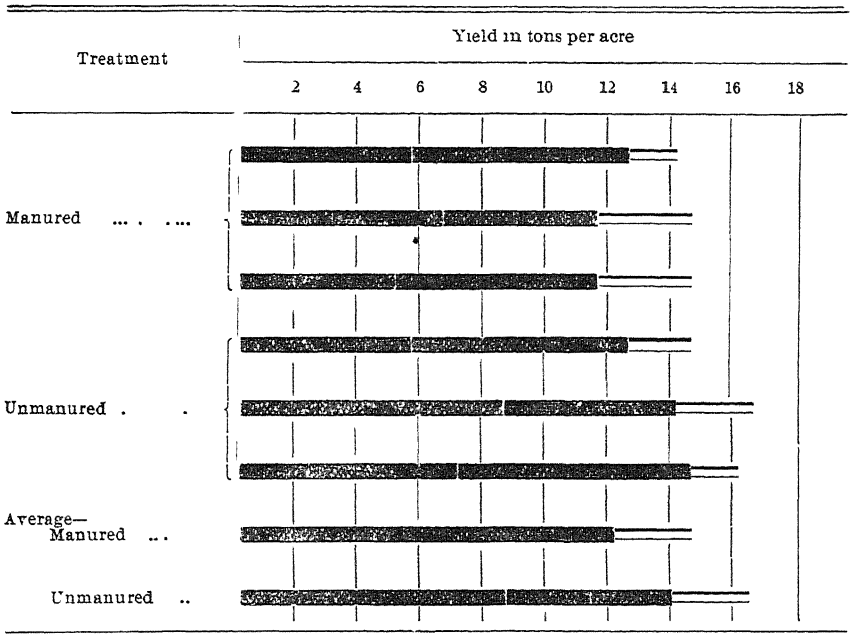
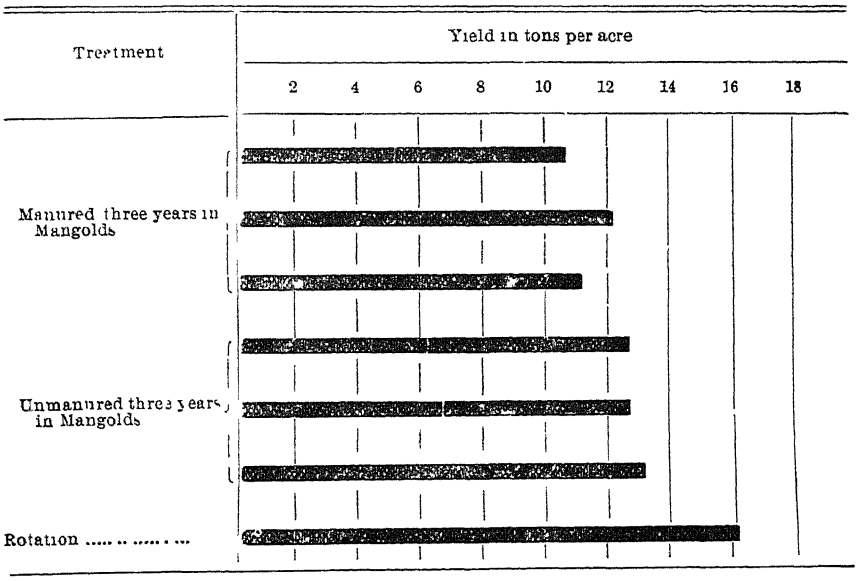


DIAGRAM II.—COMPARISON OF YIELD OF MANGOLDS GROWN UNDER CONTINUOUS CROPPING AND IN ROTATION, CROP OF 1891.



4 DISPOSAL OF BEET LEAVES

I have made two attempts to utilize the leaves and stems of mangold wurzels and sugar beets. In 1890 I put about two tons of these leaves and stems into the silo, which at the time was about three-fourths full of ensilage corn; on top of these from twelve to fifteen tons of the ensilage corn were cut and pressed. When taken out, the ensilage both above and below was in good feeding condition, but the beet tops were considerably darker than when put in, and were a shiny and unpalatable mass. The cows ate a very small portion but without relish.

In 1890 a pit was dug in the beet patch about six feet deep and four feet square; around the outside planks were placed side by side, forming a complete wall, and extending above ground about two feet. This pit was filled with tops until they formed a cone above the ends of the boards. The entire part above ground was then covered with about two feet of earth and left in that condition until the following April. When opened and about six inches taken off the outside the balance was but slightly changed in color, but it possessed a pungent odor that reminded one of a cess-pool. When given to the stock they ate only a very little of it.

In Farmers' Bulletin No 3, issued by the United States Department of Agriculture, we find the following, which is very important in this connection. Speaking of sugar beets Dr. Wiley says

"The constituents to be taken into account in the necessary restitution to the soil for beets are potash, phosphoric acid, magnesia and nitrogen. Following are the quantities of these constituents in 1,000 pounds of beets and beet leaves, averaged from numerous analyses:

Constituents.	Roots.	Leaves.
	Pounds	*Pounds*
Potash	3 3	6.5
Phosphoric acid	0 8	1 3
Magnesia	0 5	3 0
Nitrogen	1 6	3 9
Total ash	7 1	18 1

"It will be seen from the relation between the roots and leaves that the amounts abstracted by the latter are considerably greater and deserve especial consideration in case the leaves are not left in the field. From this point of view the leaves should be left in the field."

5. SUGGESTIONS FOR THE BEGINNER IN BEET CULTURE.

Mangold wurzels and sugar beets do not require a particular kind of soil; in general, it may be said that land which will produce a crop of potatoes, corn or wheat, will, with proper cultivation, grow a fair crop of mangolds or sugar beets The deeper the soil the better, and if it is not possible to plow eight or ten inches deep then it should be sub-soiled A clover sod furnishes the best possible preparation as a preceding crop The land should be thoroughly plowed during the winter or early spring, and the further preparation should be not merely passable but good, stirring, harrowing, rolling, until the ground is mellow and free from clods. The marking should be done with a sled, making no furrow, but simply a mark that may be followed with a hand drill, or possibly dropping by hand An allowance of from 5 to 6 pounds of seed per acre will not be too much if a drill is used. The seed should be planted from the 20th of April to the 1st of May, and should be soaked in water two or three days before planting This will hasten the growth, giving the young plants a better start before the weather becomes dry, as it often does in June. Planting a seed every four inches will not be too thick, as they will have to be thinned out later in the season, leaving one plant to every eight, ten or twelve inches, depending somewhat upon kind The seed should not be covered more than an inch deep, and should be planted just as soon after the ground is fitted as possible, so that the roots may have a fair chance with the weeds. More labor will be required during the first three weeks after the mangolds appear above ground than during all the rest of the season. During these three weeks more or less weed pulling and hand hoeing will be required; but if thoroughly done the later cultivation may be done with Breed's weeder, and with a cultivator having narrow teeth, for the surface soil is all that it is necessary to stir. Hilling up or throwing dirt to the roots is not advised; level cultivation will accomplish all that is desired. When the leaves cover the ground fairly well cultivation may be suspended. Nothing further will be required until freezing weather approaches, before which it is advisable to have the mangolds harvested.

The first operation in harvesting is to cut off the leaves and stems down near the base; if the crown of the mangold is cut into a little no positive injury is likely to follow, but if cut deep decay is a consequence. This operation we have been able to do most rapidly by taking a corn cutter well sharpened in one hand and, raising the leaves with the other, slice them off almost as rapidly as one can walk along a row. The topper is followed by a man with a cart or a wagon into which the roots are thrown as rapidly as they can be drawn out of the ground by hand. With

the Long Red class of mangolds the pulling can be done very rapidly, but the Ovoid and Globe classes often require some plowing on either side of each row to loosen them from the soil, and even then the pulling is very much more tedious than in the Long Red class.

If the barn furnishes a root cellar, or a place for one, that is the best place to store the mangolds; but they should not be piled over four feet deep, as the weight is likely to crush the bottom ones. If the root cellar is not practicable they may be pitted the same as apples or potatoes, except that it is necessary to give them air, as they will heat if closely piled in large pits. This is done by laying an ordinary tile drain on the bottom of the place prepared to pile the roots, extending it at either end beyond the point where the dirt used in covering will reach; this will give the air a chance to pass through and at the same time will carry off any surplus heat and moisture. After the pile is about four feet high about three inches of straw should be put over the mangolds, then cover with dirt up to the top, place a joint of drain tile on end on the straw about every four or five feet along the top of the beet pile, then finish the covering, piling the dirt up around these tiles to the top. This will give a complete circulation of air through the entire pile, and if covered from eight to twelve inches deep, depending on exposure, the mangolds will keep through the entire winter if desired.

In conclusion I may say that, in my opinion, where it is not possible to have a silo, the growing and preserving of a crop of mangold wurzels or sugar beets is necessary to the economical feeding of dairy cows, and ewes that are suckling lambs. It seems to me that the silo is the proper adjunct to the larger dairies, and the more extensive flocks; but that a root crop must take its place where the number of stock kept will not justify the larger outlay necessary for building and equipping for feeding ensilage.

In a future bulletin on the feeding experiment now being conducted at the Station, some points will be given showing the relative cost of producing an acre of ensilage and an acre of mangolds; also the value of the food produced on each acre.

SUMMARY.

1. While new seed is not an absolute necessity to insure a crop of mangolds, it is better to use new seed if it can be had.

2. Testing of mangold wurzel or sugar beet seed before planting is considered indispensable.

3. In each class or variety of mangolds are found several strains, and while these do not differ materially, some have qualities that make them more desirable than others.

(*a.*) In the Long Red class the Giant Long Red has, in a series of years, seemed to have more vitality in the seed used, and has given a more satisfactory average growth than any other one of that class.

(*b.*) The Giant Holstein, Dignity and Jumbo have all made occasional higher yields than the Giant Long Red, and are among the the best sorts in that class.

(*c.*) The Giant Yellow Intermediate, Yellow Ovoid and Yellow Leviathan are among the better kinds in the Ovoid class.

(*d.*) The Globe class as a whole has been the least valuable type of mangolds.

4. According to the experiments detailed in this bulletin, an acre of sugar beets, properly grown, is decidedly more valuable for feeding stock than an acre of mangold wurzels.

5. The sugar beets grown at this Station during the past year have shown a percentage of sugar too small to justify growing them for sugar making purposes.

6. (*a.*) Transplanting mangolds has not been attended with satisfactory results, except in filling up rows to make a more perfect stand.

(*b*) Cutting off the leaves when transplanting has not been any benefit.

7. (*a.*) Manuring land with fresh barn yard manure has been detrimental to the growing of mangolds and has in every case decreased the yield.

(*b.*) Continuous cropping with mangolds has resulted in reducing the ability of the land to produce this crop by at leat 10 per cent. each year for the first three years.

8. (*a.*) Preserving the leaves in the silo with corn ensilage has not been found practicable.

(*b.*) It has been found possible to preserve them in a well or cistern in the ground with but little loss, but they were not relished by the stock, even when well kept.

(*c.*) On account of the large proportion of fertilizing elements in the leaves it is advisable to leave them upon the ground.

NOTICE.

The possibility of profitable culture of the sugar beet for sugar making purposes in the northern third of Ohio is not yet determined, and if farmers in this region will cultivate a small lot of such beets during the coming season and send samples of the crop to this Station in October or November, together with a statement showing the kind of soil upon which the beets were grown, the percentage of sugar will be determined free of charge.